# Look and Feel: The Importance of Sensory Feedback in Virtual Product Experience

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# Look and Feel: The Importance of Sensory Feedback in Virtual Product Experience

*Short Paper*

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## Abstract

*Despite the ubiquity of e-commerce, conveying sensible online shopping experience remains a challenge for online marketers. This study explores how sensory feedback provided by various interaction technologies shapes consumers' online shopping experience. Drawing on the literature on virtual product experience and sensory marketing, we investigate the impacts of different sensory feedback (i.e., visual feedback and haptic feedback) on consumers' product perception (i.e., product tangibility) and virtual product experience (i.e., perceived shopping risk, purchase intention, and shopping satisfaction). Moreover, we take the congruence of different sensory feedback into consideration and examine its moderating impact on the effects of visual feedback and haptic feedback. A laboratory experiment is designed to test our research hypotheses. We also discuss the theoretical contributions and practical implications of this study.*

**Keywords:** Sensory feedback, sensory congruence, virtual product experience

## Introduction

The mediated nature of e-commerce inhibits consumers from directly exploring and examining products prior to purchase. Previous research suggests that indirect shopping experience makes consumers feel uncertain about products (Hoch 2002; Smith and Swinyard 1982). When consumers find product information ambiguous and unconvincing, their perception of shopping risk is likely to increase, resulting in unsatisfied shopping experience (Eggert 2006; Laroche et al. 2004).

Aiming to improve consumers' online shopping experience, marketers are adopting various technologies to enhance consumers' ability in evaluating products. On one hand, *interactive image tools* (e.g., ShoogleIt and Flash) are widely employed to convey enriched product visual information (Jiang and Benbasat 2004; Overmars and Poels 2015). Different from static product images, interactive product images created by interactive image tools can respond to consumers' actions by changing the graphics of products. For example, an interactive image of a scarf will get wrinkled in response to consumers' mouse clicking. In such

a case, interactive image tools provide consumers with concurrent visual feedback, resembling consumers' direct contact with products.

On the other hand, the emergence of *touchscreen devices* (e.g., tablets and smartphones) may affect consumers' online shopping experience by allowing users to interact with products using natural hand movements. In this case, consumers obtain smooth, cold, and solid haptic feelings when they press their fingers on the glasslike surface of touchscreen devices (Rokeby 1998). Moreover, touchscreen devices with 3D touch function (e.g., iPhone X) give consumers a minor vibration when consumers press the surface with force. The haptic feedback enabled by touchscreen devices likely makes consumers feel they are physically examining products.

Despite the prevalent use of the aforementioned technologies in e-commerce, empirical research investigating their impacts on consumers' shopping behavior still lags in two critical aspects, which motivate our study. First, prior research on virtual product experience has focused on the design and use of technologies to facilitate consumers' experiencing and learning of products (e.g., Jiang and Benbasat 2004; Jiang and Benbasat 2007a). However, scant attention has been paid to the impacts of sensory feedback enabled by different technologies on consumers' product learning. Given the vital role of consumers' sensation in influencing their judgment and behavior (Krishna and Schwarz 2014), understanding consumers' responses to sensory feedback will help improve their online shopping experience.

Second, sensory feedback from multiple sensory modalities typically interacts to affect consumers' perception and behavior (Krishna 2006). In an online context, however, sensory feedback may not always be congruent with each other because it is enabled by interaction technologies rather than directly experienced. As the role of sensory feedback has been largely overlooked in an online context, the effects of multisensory congruence on consumers' online shopping experience deserve further investigation.

The objective of this research is to explore the impacts of sensory feedback (i.e., visual feedback and haptic feedback) and their congruence on consumers' online shopping experience. This study presents an initial exploration into the impacts of multisensory feedback in Human-Computer Interaction literature and elucidates the need for further inquiries into online consumers' multisensory experience. In the next section, a literature review on virtual product experience is first conducted, followed by a discussion on the impacts of sensory information on consumer perception.

# Literature Review

## *Virtual Product Experience*

Online shopping restricts consumers' ability to feel and examine products before purchase, thus raising barriers to consumers' product evaluation and learning (Jarvenpaa and Todd 1996). To overcome such barriers and resemble actual shopping experience in the online context, various IT artifacts have been designed to enable *virtual product experience (VPE)*, i.e., an online experience that simulates consumers' feel, touch, and trial of products (Jiang and Benbasat 2004).

Prior research on VPE has investigated the impacts of IT artifacts on consumers' product evaluation and learning. For example, it is suggested that presentation formats incorporating video and 360-spin rotation (versus static image and plain text) depict product information in a more realistic way, thus facilitating consumers' learning of products (Jiang and Benbasat 2007b; Li et al. 2001; Suh and Lee 2005). Similarly, visual and functional control (Jiang and Benbasat 2004; Jiang and Benbasat 2007b; Schlosser 2003), 3D presentation (Nah et al. 2011; Steinmann et al. 2014) and virtual mirror applications (Verhagen et al. 2014) have also been found able to enhance online consumers' capability in product evaluation.

Despite the numerous efforts on designing and employing various IT artifacts to aid consumers' product evaluation and learning, most of the previous studies have focused on the effects of visual information. Given the rapid development of interaction technologies, especially touchscreen devices, online consumers now can browse and interact with products using their hands. When moving their fingers on touchscreens, consumers can gain haptic feelings. However, limited attention has been paid to the role of haptic information in the online context. Moreover, information obtained through touch may interfere with visual information (Krishna 2006; Welch and Warren 1986). To better understand the interplay between visual

and haptic information and its effect on consumers' virtual product experience, we review prior work on the impacts of sensory information.

## *Sensory Information and Consumer Perception*

People acquire information through their senses and the obtained sensory information helps people form impressions of objects (Krishna 2012; Schifferstein et al. 2013). Studies on sensory marketing suggest that sensory information plays a critical role in affecting consumers' perception, judgment, and behavior (Krishna 2012). Given the dominance of vision and haptics in influencing consumers' product evaluation (Schifferstein and Cleiren 2005), this study focuses on the impacts of visual and haptic information on consumer perception and behavior.

### Impacts of Visual Information

Vision is often regarded as people's most important sensory modality in acquiring information (Sigrist et al. 2013). Researchers have argued that visual depictions of products (e.g., product images) can affect consumers' product perception and their product choice (e.g., Elder and Krishna 2012; Krishna 2012). For example, Cian et al. (2014) found that when product images successfully elicited consumers' dynamic imagery, consumers would be more engaged with the product and form a better attitude toward the brand.

It is suggested that exposure to visual presentations of products may facilitate consumers' mental simulations of interacting with the products (e.g., Elder and Krishna 2012; Schlosser 2003). That is, consumers likely form vivid mental imagery of themselves using the product when they are viewing visual depictions of the product. For example, Elder and Krishna (2012) examined the impact of product images with different product orientations (i.e., orient toward a participant's dominant hand vs. non-dominant hand) on consumers' purchase intention. It was found that viewing product image (e.g., a steel mug with handle) that oriented toward a consumer's dominant hand facilitated the consumer's mental simulation of interacting with the product (e.g., holding the handle and using the mug to drink water), leading to higher purchase intention. Indeed, consumers' mental simulation of products can generate product-related cognitive activities, which further affect consumers' product evaluation (Barsalou 2008).

### Impacts of Haptic Information

The importance of haptics for consumers' shopping experience has been demonstrated in many studies. It is suggested that haptic information obtained through touch is inherently related to consumers' product evaluation (Peck and Childers 2003b) and product choice (Peck and Wiggins 2006). For example, Peck and Childers (2003b) found that haptic information increased consumers' confidence in judging the quality of products.

The impact of haptic information can be explained by research on embodiment (Herbert and Pollatos 2012; Schwarz and Clore 2007). In specific, consumers use their concurrent bodily experiences as a source of information in forming judgments (Krishna and Schwarz 2014; Schwarz 2012). For instance, when holding a cup of hot coffee, consumers may obtain a haptic feeling of warmth. Such a haptic feeling would further lead consumers to perceive others as socially warm (Williams and Bargh 2008). Similarly, feelings-as-information theory (Schwarz 2012) posits that consumers often rely on their bodily sensations (e.g., haptic information) to make decisions.

### Multisensory Interactions and Sensory Congruence

Even though sensory modalities appear independent from each other, previous research suggests that multisensory information interacts with one another to affect consumers' perception and behavior (Krishna 2006; Welch and Warren 1986). For example, Krishna (2006) focused on the interplay between visual and haptic information. It was shown that the impact of visual information was more prominent than that of haptic information when both of them were used for containers' volume judgment. However, when consumers were visually occupied, their perceptions of containers' volume depended more on haptic information than when they were not visually occupied.

Although some researchers propose that consumers' product learning will be greatly enhanced if they could acquire product information from multiple sensory modalities (Jiang and Benbasat 2007a; Mooy and

Robben 2002), other researchers argue that the effect of multisensory information depends on the *congruence* between different sensory modalities (e.g., Krishna et al. 2010). Indeed, studies on cue congruence have unraveled that the congruence of two stimuli could lead to faster recognition and improved information processing (Laurienti et al. 2002; Mandler 1982). For example, Krishna et al., (2010) investigated the impact of smell-touch congruence in semantic associations on consumers' product evaluation. In their experiment, a rough paper was selected to be associated with masculine while a smooth paper was selected to be related to feminine. They found that compared with smell-touch incongruence (i.e., rough paper with feminine scent or smooth paper with masculine scent), smell-touch congruence (i.e., rough paper with masculine scent or smooth paper with feminine scent) enhanced participants' evaluations of the papers.

In e-commerce, sensory information is sometimes inconsistent across modalities due to its mediated nature. For instance, consumers may perceive a knitted sweater as soft and fibrous when they see its product images. However, the haptic experience acquired through touching the surface of a touchscreen device may lead them to feel that the texture of the sweater is solid and smooth. The incongruent sensory information could result in consumers' conflicting mental simulations of products, leading to unwanted consequences, such as inadequate product evaluation and purchase hesitation.

Even though various interaction technologies have been widely adopted to provide consumers with multisensory information and help consumers construct a vivid mental simulation of products, sensory conflicts and incongruence prevalently exist in an online shopping context. Yet, little work has examined the impact of multisensory information on consumers' product evaluation, particularly when multisensory information conflicts with one another. In this study, we aim to address this research gap by investigating the impacts of visual and haptic information and their congruence on consumers' virtual product experience.

## Research Model and Hypotheses

This study explores the impacts of multiple sensory information on consumers' online shopping experience. In particular, we focus on two types of sensory feedback, namely, visual feedback and haptic feedback. *Visual feedback* is usually enabled by interactive image tools (e.g., ShoogleIt). For example, visual feedback is available when an interactive image of a scarf responds to consumers' mouse clicking or stroking gesture by changing the fabric of the scarf. Yet, visual feedback is not available when the product image is static. *Haptic feedback*, on the other hand, refers to whether consumers' skin can get a haptic feeling when they perform an action. For instance, consumers can obtain haptic feedback by moving fingers on the surface of the touchscreen devices (e.g., iPad or iPhone). However, haptic feedback is not available when consumers interact with devices using mid-air gestures (e.g., Microsoft Kinect or Leap Motion). Mid-air gesture devices allow users to interact with products by moving their hands in the air without any physical contact with a tangible surface or controller.

In an online shopping context, the lack of physical contact with products inhibits consumers from feeling the products as tangible, thus presenting an impediment to consumers' evaluation of the products (Dimoka et al. 2012; Hong and Pavlou 2014). Indeed, *product tangibility*, which is defined as the extent to which a product has a physical presence and is accessible to consumers' senses (Laroche et al. 2001; Laroche et al. 2005), represents a crucial aspect of virtual product experience (Chowdhury et al. 2011; Jiang and Benbasat 2004; Jiang and Benbasat 2007b; Parboteeah et al. 2009). Thus, this study examines the impacts of visual feedback, haptic feedback, and their congruence on product tangibility, and further explores the impact of product tangibility on consumers' *perceived shopping risk*, *purchase intention*, and *shopping satisfaction*. Our research model is depicted in Figure 1.

Previous studies suggest that consumers attempt to form mental simulations of interacting with products when they are exposed to visual depictions of products (Elder and Krishna 2012; Schlosser 2003). The ease of forming mental simulation, then, affects consumers' perception of products. When visual feedback is available, product images change in response to consumers' actions, such as mouse clicking and finger stroking. In such a case, it is easier for consumers to access enriched product information through dynamic visual cues and comprehend product information mentally, thus facilitating a vivid simulated experience of using the products (Fiore et al. 2005). Because the formation of consumers' mental simulations is greatly facilitated in the presence of visual feedback, consumers may perceive the product as more tangible. On the

contrary, when visual feedback is not available, it would be difficult for consumers to imagine interacting with the products. In this case, consumers may spend efforts on retrieving their prior experiences of using the same or similar products in order to form mental simulations, driving them to perceive the product as intangible (Sigrist et al. 2013). Therefore, we hypothesize that,

***H1****: Visual feedback is positively related to product tangibility.*

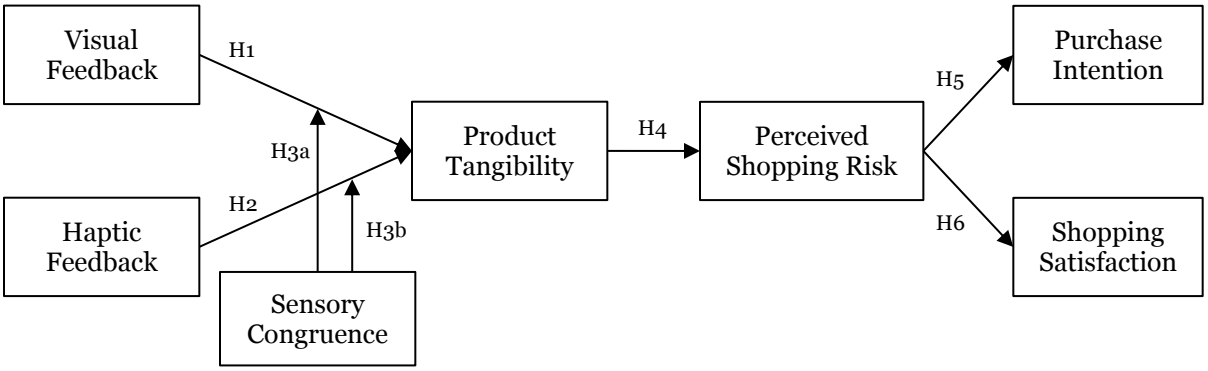


**Figure 1. Research Model**

Consumers' perception of products is also likely to be affected by their bodily sensations (Krishna and Schwarz 2014; Schwarz 2012). Despite the devoid of physical touch of products prior to purchase, online consumers may still rely on their bodily sensations to make product judgments. For example, Brasel and Gips (2014) found that haptic feedback acquired via touchscreen devices facilitated a more realistic product interaction experience, resulting in consumers' higher psychological ownership of products. When haptic feedback is available, consumers may perceive products under examination as more tangible because haptic feedback facilitates consumers' inspection of the products in a way that resembles physical product trials (Grigorovici and Constantin 2004). In contrast, consumers without haptic feedback may not have an illusion that they are actually "touching" the products because the products are inaccessible to their haptic modality. Under such circumstances, consumers would perceive the products to be impalpable, yielding lower product tangibility. Hence, we posit that,

***H2****: Haptic feedback is positively related to product tangibility.*

Consumers normally acquire product information through multisensory modalities. For example, they scrutinize a product to get its visual cues (e.g., color, size, etc.) while touching a product to obtain its haptic attributes (e.g., texture, temperature, and friction). Prior research suggests that multisensory information interacts to affect consumers' perception of products (Krishna 2006; Welch and Warren 1986). While some studies indicate that product information from multisensory modalities would improve consumers' learning of products (e.g., Jiang and Benbasat 2007a; Mooy and Robben 2002), other researchers argue that multisensory product information may sometimes conflict with each other, yielding negative consequences (Krishna 2012).

In an online shopping context, visual feedback and haptic feedback provide consumers with product information from different perspectives. On one hand, visual feedback depicts products by providing dynamic visual cues about products. For instance, an interactive image of a plush bear may be concave when consumers gently click on or stroke the belly of the bear. Such visual feedback may lead consumers to think that the plush bear is soft and light. On the other hand, haptic feedback allows consumers to acquire product information via bodily sensations. In the previous example, when consumers evaluate the plush bear via touchscreen devices, they may use their bodily sensations to infer the texture of the bear. As the surface of touchscreen devices is solid, smooth, and cold, consumers may perceive the bear as tough and cold.

It is suggested that sensory feedback from different sensory modalities may either facilitate or inhibit consumers' mental simulation of products, depending on the degree of fit between different sensory feedback in depicting the characteristics of products (i.e., sensory congruence; Krishna et al. 2010). When sensory congruence is high, sensory feedback from different modalities reinforce each other and contribute

to forming a coherent and consistent mental simulation of the product under examination. In such a case, consumers can easily imagine themselves interacting with the product. Due to the facilitated mental simulation, consumers are likely to feel that the product is tangible. When sensory congruence is low, however, sensory feedback from different modalities contradicts with each other and inhibits consumers from constructing a consistent mental simulation of the product. As a result, consumers cannot mentally perceive the characteristics of the product, yielding a negative impact on product tangibility. In addition, multisensory conflict may drive consumers to think about the actual source of sensory feedback. According to Schwarz (2012), the impact of bodily sensations (e.g., haptic feedback) gets attenuated when consumers attribute its impact to other sources (e.g., touching the surfaces of touchscreen devices). Based on the above arguments, we hypothesize that,

***H3a****: When sensory congruence is high (vs. low), the positive impact of visual feedback on product tangibility would be more prominent.*

***H3b****: When sensory congruence is high (vs. low), the positive impact of haptic feedback on product tangibility would be more prominent.*

It is generally acknowledged that consumers' product perception is vital to their judgment of shopping risk (Dowling 1999; Mittal 1999). Prior literature suggests that shopping uncertainty (i.e., the likelihood of obtaining undesirable outcomes) is an important dimension of shopping risk (Bauer 1960). Product tangibility decreases shopping risk by reducing the uncertainty involved in the shopping experience. First, high product tangibility enables consumers to form vivid mental visualization of products, thus improving consumers' product learning (Laroche et al. 2001; Laroche et al. 2005). Second, high product tangibility promotes a virtual product trial, resembling the actual usage scenarios and helping consumers form realistic expectations of product performance (Bone and Ellen 1992). Consequently, consumers would be less likely to feel uncertain and risky in the shopping process when they perceive products as tangible. Therefore, we predict that,

***H4****: Product tangibility is negatively related to perceived shopping risk.*

Perceived shopping risk increases consumers' difficulties in assessing the characteristics of the products under examination and whether the products could meet the needs of consumers (Dimoka et al. 2012). Also, consumers are generally averse to risk. Thus, perceived shopping risk has been recognized as an obstacle in eliciting consumers' purchase intention (Gefen et al. 2008; Park et al. 2005). Furthermore, perceived shopping risk may reduce consumers' confidence in their product judgment. To improve their product learning, consumers are likely to spend more time and effort on product information searching. Thus, the shopping task would become rather cognitive-demanding and tiring. In such a case, consumers may find their shopping experience less satisfactory. Hence, we hypothesize that,

***H5****: Perceived shopping risk is negatively related to purchase intention.*

***H6****: Perceived shopping risk is negatively related to shopping satisfaction.*

# Methodology

To test our proposed hypotheses, a 2 (visual feedback: available vs. unavailable) by 2 (haptic feedback: available vs. unavailable) by 2 (sensory congruence: high vs. low) between-subjects laboratory experiment is designed. In our experiment, participants are asked to evaluate some products on a simulated online shopping webpage.

Visual feedback is manipulated by varying the formats of product images. In *visual feedback available condition*, interactive images are employed to depict products. In specific, interactive product images respond to participants' actions by changing their graphics. For example, an interactive scarf image would wrinkle when being pointed or touched. In *visual feedback unavailable condition*, static images are used to present products.

We manipulate haptic feedback by providing different interaction devices to participants. In *the condition with haptic feedback*, participants will be asked to evaluate products using a touchscreen desktop. In *the condition without haptic feedback*, we provide participants with the Leap Motion controller. Leap Motion controller is a device that facilitates users' interaction with computers via mid-air gestures. Users can interact with products by pointing and moving their hands in the air above the device. In order to control

for the inherent difference interaction devices, we will ask the participants to interact with the same desktop, with either touchscreen interface enabled or Leap Motion interface enabled.

Sensory congruence is manipulated by varying the degree of fit between visual feedback and haptic feedback. As the surface of touchscreen devices is normally smooth, solid and cold, haptic feedback is more congruent with visual feedback if products share similar visual attributes (e.g., smooth, light, etc.) If products are visually rough, soft, and hot (e.g., blanket, plush toys, hot spicy dishes, etc.), there will be a mismatch between visual and haptic feedback. Thus, we select laptops as focal products in the *high sensory congruence condition* and woolen scarf as focal products in the *low sensory congruence condition*.

To eliminate the influence caused by differences in participants' experiences in using different interaction devices, participants are given sufficient time before the experiment to familiarize themselves with the interaction devices they are assigned. After completing the task, participants are required to fill out a questionnaire that captures the constructs of our interest. Items for sensory congruence adapted from Krishna et al. (2010) are measured for manipulation check. Measurement items for product tangibility, perceive shopping risk, purchase intention, and shopping satisfaction are all adapted from prior literature (Jiang and Benbasat 2007b; Laroche et al. 2001; Laroche et al. 2004; Zhang and Fitzsimons 1999). To account for individual differences in visual and haptic information processing, we included participants' demographics (e.g., age and gender) and the need for touch as control variables (Citrin et al. 2003; Peck and Childers 2003a).

## Conclusion

This study seeks to understand the effects of sensory feedback and sensory congruence in shaping consumers' virtual product experience. Our work extends current literature in several ways. First, it complements the conventional approach in studying virtual product experience by elucidating the effects of sensory feedback on consumers' product evaluation. This study brings in a new perspective arguing that consumers' product evaluation would be shaped by sensory feedback enabled by interaction technologies. Second, this study adds to a growing body of literature on multisensory human-computer interaction by highlighting the role of sensory congruence in virtual product experience. It is suggested that sensory congruence is critical in determining whether sensory feedback is helpful in shaping consumers' product evaluation.

Practically, this study explores how visual and haptic feedback could be designed and employed to improve consumers' product evaluation. First, it suggests that marketers should employ interactive images to present their product, enhancing their product tangibility and thus reducing consumers' perceived shopping risk. Second, when designing a multisensory shopping experience, marketers should take sensory congruence into consideration. Specifically, when presenting products sharing similar haptic feelings with the surfaces of touchscreen devices, marketers should encourage consumers to examine products with touchscreen devices so as to improve their product learning. However, when the haptic attributes of products are contradictory to the feelings of the touchscreen surface, mid-air gesture-based devices should be used to avoid sensory incongruence.

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